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Possibility of Total Ionizing Dose Effects measurements for LHC experiments elements in a medical facility:

the TIFPA-INFN experience

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Introduction

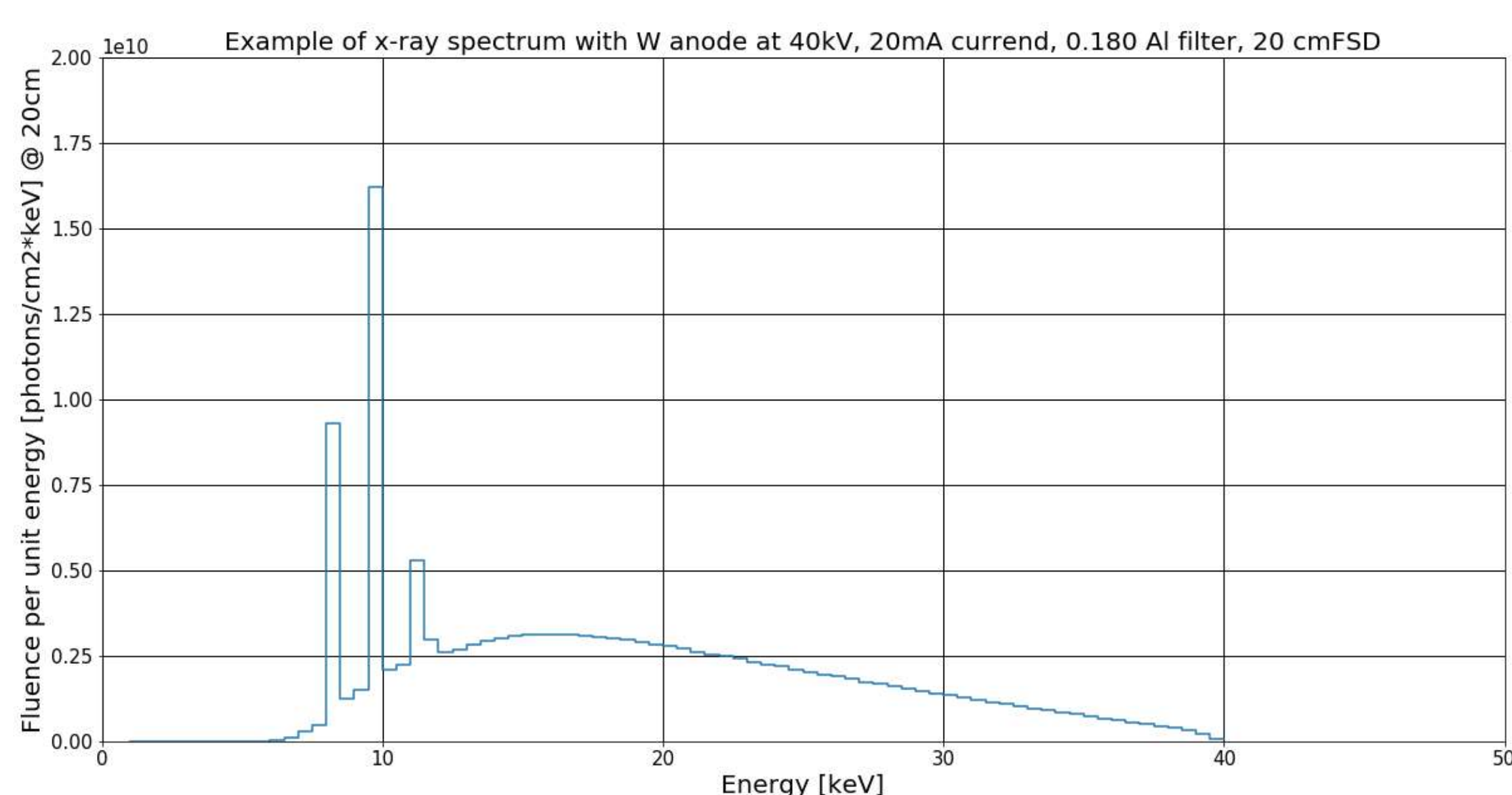
Total Ionizing Dose (TID) effects damage studies, performed with x-ray irradiation, are required measurements for solid state particle sensors and electronic control systems qualification in all the LHC present experiments and future upgrades. Some of these studies can be performed not only in facilities explicitly built for this mission⁽¹⁾, but also in medical/biophysical research facilities.

The TIFPA-INFN research center is a multidisciplinary research facility operated by the Italian National Institute of Nuclear Physics (INFN) and located in Trento (Italy). This center is equipped with different irradiation systems⁽²⁾, and between the others, with a tungsten anode 20-195 kV X-Ray station and with a PTW⁽³⁾ Farmer Chamber dose measurement system.

This station, built for biological and biophysics cells irradiation studies, was successfully used in May 2021 for SiPM TID radiation hardness characterization.

The SiPM irradiation was performed at 40 kV and 20mA current using a 0.180 mm aluminum filter.

SiPM Radiation Field Planification



Simulation realized using the SpekPy software toolkit:
<https://doi.org/10.1016/j.ejmp.2020.04.026>

Dose Measurement



Farmer Chamber dose/Si dose ratio was evaluated in the Padova INFN x-ray irradiation station comparing the PTW dose read-out against the read-out of the CERN calibrated diode for Si dose measurement during a specific irradiation session, performed in March 2021, using the planned SiPM radiation field.



In May 2021 a irradiation session was performed using the TIFPA INFN station delivering 10Mrad Si dose on FBK SiPM in 3 working days, data analysis is ongoing and results will be published.

Final Consideration

TID studies can be performed in a medical facility if low/medium Si doses are required. The ratio **(Farmer Chamber dose)/(Si dose)** have to be carefully evaluated using exactly the same irradiation conditions.

References

- https://espace.cern.ch/project-xrayese/_layouts/15/start.aspx#/default.aspx
- <https://indico.cern.ch/event/868940/contributions/3815732>
- <https://www.ptwdosimetry.com/en/products/farmer-ionization-chambers-30010-30012>

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